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PATENT
Attorney Docket No. 42.P11222

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Patent Application of	)	
	)	
Andre ZACCARIN	)	Group Art Unit: 2613
	)	
Application No.: 10/032,349 (Pub. # US 2003/0118104)	)	Examiner: Y. Lee
	)	
Filed: December 21, 2001	)	
	)	
For: SYSTEM, METHOD, AND SOFTWARE FOR ESTIMATION OF MOTION VECTORS	)	
	)	
	)	

APPEAL BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Appellant submits herewith an Appeal Brief as required by 37 C.F.R. § 41.37. This Appeal Brief is in response to the Final Office Action dated August 31, 2005 and the Advisory Action dated November 22, 2005.

I. REAL PARTY IN INTEREST

The real party in interest is Intel Corporation, a corporation of Delaware.

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I hereby certify that this correspondence is being facsimile transmitted to the U.S. Patent and Trademark Office on the date shown below	
By: Cathy Dikes Cathy Dikes	Date: February 28, 2006

II. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences known to Appellant which relate to, directly affect or are directly affected by the Board's decision in this appeal.

III. STATUS OF THE CLAIMS:

Claims 1-30 remain pending.

Claims 1-30 stand finally rejected under 35 U.S.C. § 102(b) as being anticipated by Liu et al. ("New Fast Algorithms for the Estimation of Block Motion Vectors," IEEE Int'l Symp. on Circuits & Systems, pp. 148-157, April 1993)[1].

The rejections of claims 1-30 are appealed. These claims are reproduced in the attached Claims Appendix.

IV. STATUS OF AMENDMENTS:

A Response After Final was filed on October 31, 2005, but it contained no proposed amendments.

V. SUMMARY OF THE INVENTION:

Regarding independent claims 1, 10, 19, and 29, a method, medium, or encoder may include defining a search area of the reference frame (Fig. 2, block 220; Fig. 3, elements 320 and 322; page 5, lines 2-20); defining a plurality of K search sets $S_1..S_K$ based on the search area, each search set S_i, for i=1 to K, identifying pixels from an i-th column or row of the search area, with each pixel in each search set identifying a respective block of pixels (Fig. 2, block 230; Fig. 3, exploded search area; page 6, lines 11-27); determining a set of K candidate blocks $B_1..B_K$, with each block B_i, for i=1 to K, identified by a pixel in search set S_i and minimizing a first distortion function relative to the target block, the first distortion function based only on a set of two or more collinear pixels from the target block and a set of two or more collinear pixels from block B_i (Fig. 2, block 230; page 5, line 22 to page 6, line 10; page 7, lines 2-12); determining which of the K candidate blocks $B_1..B_K$ minimizes a second distortion function

[1] This reference is Appellant's own paper, co-authored with Bede Liu and published more than 8 and one-half years prior to the filing of this application. Appellant submitted it in an IDS on January 22, 2004.

relative to the target block (Fig. 2, block 240; page 7, line 13 to page 8, line 4); and estimating the motion vector based on the target block and one of the K candidate blocks that minimizes the second distortion function (Fig. 2, block 250; page 8, lines 5-12).

Regarding independent claims 16 and 25, an encoder or system may include means for defining a search area of the reference frame (Fig. 2, block 220; Fig. 3, elements 320 and 322; page 5, lines 2-20; Fig. 1, elements 140 and 142; page 3, line 16 to page 4, line 12); means for defining a plurality of K search sets $S_1..S_K$ within the search area, each search set S_i, for i=1 to K, identifying pixels from an i-th column of the search area, with each pixel in each search set associated with a block of pixels (Fig. 2, block 230; Fig. 3, exploded search area; page 6, lines 11-27; Fig. 1, elements 140 and 142; page 3, line 16 to page 4, line 12); means for determining a set of K candidate blocks $B_1..B_K$, with each block B_i, for i=1 to K, corresponding to one block of pixels associated with a pixel of search set S_i and minimizing a first distortion function relative to the target block, the first distortion function based only on a set of two or more collinear pixels from the target block and a set of two or more collinear pixels from block B_i (Fig. 2, block 230; page 5, line 22 to page 6, line 10; page 7, lines 2-12; Fig. 1, elements 140 and 142; page 3, line 16 to page 4, line 12); means for determining which one of the K candidate blocks $B_1..B_K$ minimizes a second distortion function relative to the target block (Fig. 2, block 240; page 7, line 13 to page 8, line 4; Fig. 1, elements 140 and 142; page 3, line 16 to page 4, line 12); and means for estimating the motion vector based on the target block and the one of the K candidate blocks that minimizes the second distortion function (Fig. 2, block 250; page 8, lines 5-12; Fig. 1, elements 140 and 142; page 3, line 16 to page 4, line 12).

VI. GROUNDS OF REJECTION:

A. Claims 1-30 stand finally rejected under 35 U.S.C. § 102(b) over Liu et al.

VII. ARGUMENT:

A. Claims 1-30 are patentable under 35 U.S.C. 102(b) over Liu et al.

The Examiner is apparently of the opinion that Appellant is claiming material identically disclosed in his own paper published over 8 ½ years prior to filing this application. The Examiner is mistaken as explained below.

1. Claims 1-9 and 16-26 are patentable under 35 U.S.C. 102(b) over Liu et al.

Appellant respectfully traverses the § 102(b) rejection of claims 1-9 and 16-26 over Liu et al. Independent claims 1, 16, 19, and 25 require a method, encoder, medium, and system including, *inter alia*, "determining a set of K candidate blocks $B_1..B_K$, with each block B_i, for i=1 to K, identified by a pixel in search set S_i and minimizing a first distortion function relative to the target block; and determining which [one] of the K candidate blocks $B_1..B_K$ minimizes a second distortion function relative to the target block." Liu et al. fails to disclose all elements of the claimed method, encoder, medium, and system set forth in claims 1, 16, 19, and 25.

a. No disclosure of "a second distortion function":

Page 3 of the First Office Action[2] dated April 25, 2005, alleges that the claimed first distortion function is met by "MAD" (e.g., equation 1 on page 148 of Liu et al.) and somewhat cryptically refers to a "sub-block" with regard to the claimed second distortion function. See First Office Action, page 2, last two lines. Liu et al., however, fails to disclose at least minimizing a second distortion function as claimed. The only other numbered equation, equation 2 on page 148 of Liu et al., describes a motion vector, and not another distortion function, as set forth in claims 1, 16, 19, and 25.

i. Examiner's response:

On page 2 of the Final Office Action, the Examiner responds that "the features upon which applicant relies (i.e., minimizing a second distortion function) are not recited in the rejected claim(s)."

ii. Appellant's reply:

Each of independent claims 1, 16, 19, and 25 requires, *inter alia*, "determining which [one] of the K candidate blocks $B_1..B_K$ minimizes a second distortion function relative to the target block." By its plain language, this limitation requires both the presence of a second distortion function and the determination of which candidate block minimizes it relative to the target block. The determined candidate block, then, is the one that "minimizes a second distortion function."

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[2] The Final Office Action dated August 31, 2005, incorporates the substance of the rejections of claims 1-9 and 16-26 only by reference to the First Office Action dated April 25, 2005. These will be referred to as "the First Office Action" and "the Final Office Action" herein.

Contrary to the Final Office Action, the relied-upon features (i.e., minimizing a second distortion function and determining which block so minimizes that function) are present in claims 1, 16, 19, and 25, and the Examiner's misleading allegation does nothing to show where in Liu et al. these features may be found. The § 102(b) rejection of claims 1, 16, 19, and 25 should be reversed for this reason.

b. No disclosure of "determining which [one] of the K candidate blocks $B_1..B_K$ minimizes a second distortion function relative to the target block":

Liu et al. only discloses minimization of a single distortion function in equation 1 on page 148. Liu et al. does not disclose, either expressly or inherently, either the existence of a second distortion function, or determining which block minimizes such a second distortion function, as required by claims 1, 16, 19, and 25. That Liu et al. discloses sub-block motion-field estimation on pages 152 and 153 does not cure this lack of a second distortion function. Nor does Liu et al. disclose "determining which [one] of the K candidate blocks $B_1..B_K$ minimizes a second distortion function" for the K candidate blocks for which "minimizing a first distortion function relative to the target block" was performed. Pages 152 and 153 of Liu et al. disclose neither the claimed K candidate blocks, nor determining one of K candidate blocks that minimizes a distortion function.

i. Examiner's response:

Page 3 of the Final Office Action alleges that "Sections III and IV of Liu et al disclose the concept of such sub-block division of the candidate blocks to estimate the motion vectors that reduces the computation when the MAD between the sub-blocks is minimized as in Equation (2)."

ii. Appellant's reply:

Section III of Liu et al. concerns subsampling of motion fields by only using, for example, every other block in a frame. Note that the "subsampling" refers to a field or frame, and not to a block. Section III does not concern "sub-block division" as alleged in the Final Office Action.

Appellant specifically traverses the characterization of the blocks in Liu et al. as "candidate blocks." The techniques as described in sections II, III, and IV are discrete and non-cumulative. See page 154, at the bottom of the first column:

> So far in this paper, we have introduced three techniques . . . In this section [V], we combine the pixel decimation technique . . . presented in Section II, with the subsampled and the sub-block motion field-estimation techniques of Sections III and IV

Hence, it is factually incorrect to imply that the sub-block technique of Section IV somehow operates on "candidate blocks" produced in another section.

Even Section V on pages 154-156 of Liu et al., which (unlike Section IV) does disclose combination of the various techniques, but which was not cited in the Final Office Action, fails to teach or suggest "determining a set of K candidate blocks $B_1..B_K$, with each block B_i, for i=1 to K, identified by a pixel in search set S_i and minimizing a first distortion function relative to the target block; and determining which [one] of the K candidate blocks $B_1..B_K$ minimizes a second distortion function relative to the target block" as claimed. The § 102(b) rejection of claims 1, 16, 19, and 25 should be reversed for this additional reason.

c. No *prima facie* showing for either "second distortion function" or "determining . . ." limitations mentioned above:

The Examiner has not presented sufficient evidence in either the First Office Action or the Final Office Action to establish a *prima facie* case of anticipation over Liu et al. No evidence has been presented in the First Office Action (see page 3, last two lines) or the Final Office Action (see page 3, lines 2-6) of where in Liu et al. either the claimed "second distortion function" or "determining which [one] of the K candidate blocks . . ." limitations may be found. As with obviousness, the Examiner also bears the burden of factually supporting a *prima facie* case of anticipation (see, e.g., M.P.E.P. § 2142). To date, this crucial, factual support from Liu et al. has not been provided, and a *prima facie* case of anticipation has not been established for claims 1, 16, 19, and 25.

Liu et al. fails to disclose all elements of claims 1, 16, 19, and 25. Also, the Examiner has not made a sufficient evidentiary showing regarding the disputed claim limitations. Thus, the § 102(b) rejection of these claims over Liu et al. is improper and should be reversed.

Dependent claims 2-9, 17, 18, 20-24, and 26 are allowable at least due to their dependence from claims 1, 16, 19, and 25.

2. Claims 10-15 and 27-30 are patentable under 35 U.S.C. 102(b) over Liu et al.

Appellant respectfully traverses the § 102(b) rejection[3] of claims 10-15 and 27-30 over Liu et al. Independent claim 10 requires a method including, *inter alia*, "determining a first distortion measure based at least on pixels of the target block and the first minimum block that are outside the first row or column of the target block and the first minimum block; determining a second distortion measure based at least on pixels of the target block and the second minimum block that are outside the second row or column of the target block." Independent claim 27 requires an encoder including, *inter alia*, "a first minimization module that determines a set of K candidate blocks $B_1..B_K$, with each block B_i, for i=1 to K, minimizing a respective first distortion function relative to the target block, the respective distortion function based only on a set of two or more collinear pixels from the i-th row or column of the target block and a set of two or more collinear pixels from the i-th row or column of block B_i; and a second minimization module that determines which of the K candidate blocks $B_1..B_K$ minimizes a second distortion function based at least on pixels outside the i-th row or column of the target block." Independent claim 29 requires a method including, *inter alia*, "identifying a set of two or more candidate blocks in the reference frame, with each candidate block minimizing a first distortion function based on only one respective line of pixels of the target block and a corresponding line of pixels in the candidate block, the one respective line being different for each candidate block; and determining which one or more of the candidate blocks minimizes a second distortion function based on pixels from more than two lines of the target block." Liu et al. fails to disclose all elements of the claimed methods and encoder set forth in claims 10, 27, and 29.

a. Claims 10-15 and 27-30 have not been rejected:

None of claims 10-15 and 27-30 has yet been properly rejected. The Final Office Action merely refers back to the "same reasons" set forth in the First Office Action. The First Office Action, however, only contained a rejection of claims 1-9 and 16-26, because claims 10-15 and 27-30 were withdrawn from consideration at the time. See First Office Action, page 1 (section 4a), and page 2 (last two lines). Thus, claims 10-15 and 27-30 have not been properly rejected under § 102(b).

[3] Appellant does not, by this traversal, admit that such a rejection was actually made. See subsection a.

The Examiner attempts to cure this defect in the Advisory Action, stating "applicant explicitly states that Groups I-IV are not patentably distinct. Therefore, the rejection is equally applicable to all claims in the groups."

In response, Appellant notes that traversing an improper restriction requirement merely explains to the examiner that all claims are directed to the same invention. It *does not* absolve the Examiner of the responsibility to act on the claims, should the traversal be successful. See M.P.E.P. § 821.01:

> If the examiner, upon reconsideration, is of the opinion that the requirement for restriction is improper >in whole or in part<, he or she should . . . give an action on the merits of all the claims directed to the elected invention and any invention rejoined with the elected invention.

The Examiner did not follow this guidance. Thus, the § 102(b) rejection of claims 10-15 and 27-30 should be reversed, because such rejection was never properly made in the first place.

b. Liu et al. fails to disclose all claim limitations:

Even if the rejection of claims 1-9 and 16-26 somehow were to apply to claims that were withdrawn at the time, claims 10-15 and 27-30 contain different claim limitations than claims 1-9 and 16-26. For example, claim 10 requires, among other things, determining a first distortion measure "based at least on pixels of the target block and the first minimum block that are outside the first row or column of the target block and the first minimum block." Independent claims 27 and 29 also contain limitations that differ in substance from those in claims 1-9 and 16-26. These differing claim limitations have not been read with particularity on Liu et al. Even if they had been, Liu et al. fails to disclose these differing claim limitations in claims 10-15 and 27-30.

In particular, Liu et al. fails to disclose at least "determining a second distortion measure based at least on pixels of the target block and the second minimum block that are outside the second row or column of the target block," as set forth in claim 10, and "determining which one or more of the candidate blocks minimizes a second distortion function based on pixels from more than two lines of the target block," as set forth in claim 29. Liu et al. also fails to disclose at least "a second minimization module that determines which of the K candidate blocks $B_1..B_K$ minimizes a second distortion function based at least on pixels outside the i-th row or column of

the target block," as set forth in claim 27. Rather, Liu et al. only appears to disclose a single function (i.e., equation 1 on page 148) that could arguably be termed a distortion function.

Because Liu et al. fails to disclose all elements of claims 10, 27, and 29, the § 102(b) rejection over Liu et al. is improper and should be reversed for this additional reason.

Dependent claims 11-15, 28, and 30 are allowable at least due to their dependence from claims 10, 27, and 29.

CONCLUSION

For the reasons set forth above, Appellant respectfully solicits the Honorable Board to reverse the Examiner's rejection of claims 1-30.

To the extent necessary, a petition for an extension of time under 37 C.F.R. § 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account No. 50-0221 and please credit any excess fees to such deposit account.

Respectfully submitted,

Dated: February 28, 2006

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VIII. <u>CLAIMS APPENDIX</u>

1. (original) A method of estimating a motion vector for a target block of pixels in a target frame relative to a reference frame, the method comprising:

defining a search area of the reference frame;

defining a plurality of K search sets $S_1..S_K$ based on the search area, each search set S_i, for i=1 to K, identifying pixels from an i-th column or row of the search area, with each pixel in each search set identifying a respective block of pixels;

determining a set of K candidate blocks $B_1..B_K$, with each block B_i, for i=1 to K, identified by a pixel in search set S_i and minimizing a first distortion function relative to the target block, the first distortion function based only on a set of two or more collinear pixels from the target block and a set of two or more collinear pixels from block B_i;

determining which of the K candidate blocks $B_1..B_K$ minimizes a second distortion function relative to the target block; and

estimating the motion vector based on the target block and one of the K candidate blocks that minimizes the second distortion function.

2. (original) The method of claim 1:

wherein the search area includes N rows or columns, with N >K; and

wherein each search set S_i only identifies one or more pixels from the i-th row or column and one or more pixels from every (i+nK)-th row or column of the search area, which satisfies: i+nK.N, for n = 1, 2, 3, and so on.

3. (original) The method of claim 1, wherein each pixel in each search set occupies the upper left position of its associated block of pixels.

4. (original) The method of claim 1, wherein each row or column of pixels in the search area consists of a first number of pixels; and wherein each search set S_i identifies less than the first number of pixels.

5. (original) The method of claim 1, wherein the set of two or more collinear pixels

from the target block consists of pixels in the i-th row or column of the target block and the set of two or more collinear pixels from block B_i consists of pixels from the i-th row or column of block B_i..

6. (original) The method of claim 1, wherein the plurality of K search sets $S_1..S_K$ are mutually exclusive.

7. (original) The method of claim 1, wherein the second distortion function is based on all the pixels of the target block.

8. (original) The method of claim 1, wherein the recited acts are performed in the recited order.

9. (original) The method of claim 1, wherein K is 16 and each block consists of 16 rows or 16 columns.

10. (original) A method of estimating a motion vector for a target block of pixels in a target frame relative to a reference frame, the method comprising:

determining a first plurality of partial distortion measures, each based only on a first row or column of pixels of the target block and a corresponding first row or column in a respective one of a first plurality of blocks in the reference frame, the first plurality of blocks including a first minimum block associated with a minimum of the first plurality of distortion measures;

determining a second plurality of partial distortion measures, each based only on a second row or column of pixels of the target block and a corresponding second row in a respective one of a second plurality of blocks in the reference frame, with the second plurality of blocks including a second minimum block associated with a minimum of the second plurality of distortion measures;

determining a first distortion measure based at least on pixels of the target block and the first minimum block that are outside the first row or column of the target block and the first minimum block;

determining a second distortion measure based at least on pixels of the target block and

the second minimum block that are outside the second row or column of the target block; and

determining the motion vector based on the target block and the one of the first and second minimum blocks associated with the lesser of the first and second distortion measures.

11. (original) The method of claim 10:

wherein each first partial-distortion measure is based on all the pixels in the first row of the target block and all the pixels in the corresponding first row of its respective block in the first plurality of blocks;

wherein the first distortion measure is based on all the pixels of the target block and the first minimum block and the second distortion measure is based on all the pixels of the target block and the second minimum block; and

wherein the recited acts are performed in the order recited.

12. (original) The method of claim 10:

wherein each block in the first and second pluralities of blocks is rectangular, and is identified by coordinates of its upper left pixel, with each upper left pixel within a search area of the reference frame, the search area having a plurality of columns of pixels, including at least one first column and at least one second column; and

wherein the upper left pixel of each of the first plurality of blocks is within a first column of the search area, and the upper left pixel of each of the second plurality of blocks is within a second column of the search area.

13. (original) The method of claim 12, wherein each column of the search area consists of N pixels and each of the first and second pluralities of blocks includes less than N blocks.

14. (original) The method of claim 12:

wherein the first and second pluralities of blocks are mutually exclusive; and

wherein the search area includes more than one first column and more than one second column, with the first plurality of blocks including at least one block from each first column and the second plurality of blocks including at least one block from each second column.

15. (original) The method of claim 10, wherein each first partial distortion measure is based on a sum of absolute differences of the pixels in the first row of the target block and pixels in the corresponding first row of its respective block in the first plurality of blocks.

16. (original) An image encoder including a motion estimator for estimating a motion vector for a target block of pixels in a target frame relative to a reference frame, the motion estimator comprising:

means for defining a search area of the reference frame;

means for defining a plurality of K search sets $S_1..S_K$ within the search area, each search set S_i, for i=1 to K, identifying pixels from an i-th column of the search area, with each pixel in each search set associated with a block of pixels;

means for determining a set of K candidate blocks $B_1..B_K$, with each block B_i, for i=1 to K, corresponding to one block of pixels associated with a pixel of search set S_i and minimizing a first distortion function relative to the target block, the first distortion function based only on a set of two or more collinear pixels from the target block and a set of two or more collinear pixels from block B_i;

means for determining which one of the K candidate blocks $B_1..B_K$ minimizes a second distortion function relative to the target block; and

means for estimating the motion vector based on the target block and the one of the K candidate blocks that minimizes the second distortion function.

17. (original) The image encoder of claim 16, wherein the set of two or more collinear pixels from block B_i comprises two or more pixels from a row of pixels in block B_i.

18. (original) The image encoder of claim 16:

wherein the search area includes N rows or columns, with N >K;

wherein each search set S_i identifies one or more pixels from the i-th row or column and one or more pixels from every (i+nK)-th row or column of the search area, which satisfies:

$i+nK.N$, for n = 1, 2, 3, and so on; and

wherein the first and second distortion functions are based on a sum of absolute

differences.

19. (original) A machine-readable medium for facilitating estimation of a motion vector for a target block of pixels in a target frame relative to a reference frame, the medium comprising instructions for:

defining a search area of the reference frame;

defining a plurality of K search sets $S_1..S_K$ within the search area, each search set S_i, for i=1 to K, identifying pixels from an i-th column of the search area, with each pixel in each search set S_i associated with a block of pixels;

determining a set of K candidate blocks $B_1..B_K$, with each block B_i, for i=1 to K, corresponding to one block of pixels associated with a pixel of search set S_i and minimizing a first distortion function relative to the target block, the first distortion function based only on a set of two or more collinear pixels from the target block and a set of two or more collinear pixels from block B_i;

determining which one of the K candidate blocks $B_1..B_K$ minimizes a second distortion function relative to the target block; and

estimating the motion vector based on the target block and the one of the K candidate blocks that minimizes the second distortion function.

20. (original) The medium of claim 19, wherein each pixel in each search set occupies the upper left position of its associated block of pixels.

21. (original) The medium of claim 19, wherein each column of pixels in the search area consists of a first number of pixels; and wherein each search set S_i identifies less than the number of pixels in the i-th column.

22. (original) The medium of claim 19, wherein the set of two or more collinear pixels from the target block consists of pixels on the i-th line or row of the target block, and the set of two or more collinear pixels from block B_i consists of pixels on the i-th line or row of block B_i.

23. (original) The medium of claim 19:

wherein the search area includes N rows or columns, with N >K; and

wherein each search set S_i only identifies one or more pixels from the i-th row or column and one or more pixels from every (i+nK)-th row or column of the search area, which satisfies: $i+nK \le N$, for n = 1, 2, 3, and so on.

24. (original) The medium of claim 19, wherein the second distortion function is based on all the pixels of the target block.

25. (original) A system comprising:

at least one processor;

an image decoder coupled to the processor; and

an image encoder coupled to the processor, with the image encoder including a motion estimator for estimating a motion vector for a target block of pixels in a target frame relative to a reference frame, the motion estimator comprising:

means for defining a search area of the reference frame;

means for defining a plurality of K search sets $S_1..S_K$ within the search area, each search set S_i, for i=1 to K, identifying pixels from every i-th column of the search area, with each pixel in each search set S_i identifying a block of pixels;

means for determining a set of K candidate blocks $B_1..B_K$, with each block B_i, for i=1 to K, corresponding to one block of pixels identified by a pixel of search set S_i and minimizing a first distortion function relative to the target block, the first distortion function based only on a set of two or more collinear pixels from the target block and a set of two or more collinear pixels from block B_i;

means for determining which one of the K candidate blocks $B_1..B_K$ minimizes a second distortion function relative to the target block; and

means for estimating the motion vector based on the target block and the one of the K candidate blocks that minimizes the second distortion function.

26. (original) The image encoder of claim 25, wherein the set of two or more collinear pixels from block B_i comprises two or more pixels from a line of pixels in block B_i.

27. (original) An image encoder including a motion estimator for estimating a motion vector for a target block of pixels in a target frame relative to a reference frame, the motion estimator comprising:

a first minimization module that determines a set of K candidate blocks $B_1..B_K$, with each block B_i, for i=1 to K, minimizing a respective first distortion function relative to the target block, the respective distortion function based only on a set of two or more collinear pixels from the i-th row or column of the target block and a set of two or more collinear pixels from the i-th row or column of block B_i;

a second minimization module that determines which of the K candidate blocks $B_1..B_K$ minimizes a second distortion function based at least on pixels outside the i-th row or column of the target block; and

an estimation module that estimates the motion vector based on the target block and one of the K candidate blocks that minimizes the second distortion function.

28. (original) A system comprising:

at least one processor;

an image decoder coupled to the processor; and

the image encoder of claim 27 coupled to the processor.

29. (original) A method of estimating a motion vector for a target block of pixels in a target frame relative to a reference frame, with the target block having two or more lines of pixels, the method comprising:

identifying a set of two or more candidate blocks in the reference frame, with each candidate block minimizing a first distortion function based on only one respective line of pixels of the target block and a corresponding line of pixels in the candidate block, the one respective line being different for each candidate block;

determining which one or more of the candidate blocks minimizes a second distortion function based on pixels from more than two lines of the target block; and

determining the motion vector based on one of the candidate blocks that minimizes the second distortion function.

30. (original) The method of claim 29, wherein each block comprises two or more rows of pixels, and each line of pixels comprises pixels from one respective row of pixels.

IX. EVIDENCE APPENDIX

None.

X. RELATED PROCEEDINGS APPENDIX

None.